CHAPTER 3: FISH HABITAT QUALITY

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GLOSSARY

Adfluvial: Refers to a life history where fish spawn in rivers and streams and rear in lakes. This life history is common in bull trout populations.

Anadromous: Refers to a life history where fish spawn in rivers and streams and complete at least a portion of their rearing cycle in the ocean. All the Pacific salmon species are anadromous. Landlocked populations of sockeye are sometimes found. These populations complete their entire rearing cycle in lakes and do not rear in the ocean. Such populations are referred to as kokanee rather than sockeye.

Cfs: Cubic feet per second. A measure of the amount of water passing a point. Used to represent stream flow.

LWD: Large woody debris. Refers to wood lying in the stream. LWD provides cover for fish, helps sort and trap sediment, and affects the development of pools in the stream.

Escapement: The number of fish that survive natural and human-caused mortality and spawn successfully. The sum of estimates of fishing harvest and escapement numbers result in a "run size estimate".

RM: River Mile measured from the mouth of the river or stream.

Salt Wedge: The intrusion of salt water into the lower reaches of a stream during high tide. Since fresh water floats on salt water, this intrusion is often wedge shaped, hence the name.

Stock: The fish spawning in a particular lake or stream(s) at a particular season, which fish to a substantial degree do not interbreed with any group spawning in a different place, or in the same place in a different season. Stocks can be comprised of fish of native genetic heritage, non-native heritage, or mixed genetic heritage. Production (reproduction) can be in the wild natural, supported by hatchery operations (cultured), or sustained by both artificial and natural production (composite).

Depressed stocks: Those stocks whose production is below expected levels, based on available habitat and natural variations in survival rates. Permanent damage to the stock is deemed likely. The management intent is to restore these stocks to fishable levels.

Healthy stocks: Stocks covered a wide range of conditions, from robust to those without surplus production for harvest. A healthy listing in this assessment does not mean that managers have no concerns, or that production levels are adequate (WDFW AND WWTT 1994). It should be noted that, even with positive trends, most anadromous stocks in the Nisqually basin are much lower than their historical numbers, and concerns about declines in fish habitat and fish production are not new (Phinney et al., 1975). Conditions in individual streams will vary, as will problems and opportunities for restoration.

Substrate: The rock or soil material present in the bottom of the stream or river. This includes muck, sand, gravel, boulders, and bedrock. Salmon generally spawn in gravel that is roughly 2 inches or greater. Smaller trout will use smaller pebbles for spawning. A high concentration of fines (sand and finer) in spawning gravel will suffocate eggs and young fish developing in the gravel.

Tidal Influence (on streams): Tides often influence the flow in the lower reaches of streams draining to salt water. The influence includes both the intrusion of the salt wedge and the backup of freshwater above the salt wedge, which is caused by the increase in the height of water during high tide. Hence, the tidal influence can extend a substantial distance above the salt wedge.

CHAPTER 3: FISH HABITAT QUALITY

INTRODUCTION

This section summarizes available information on the fish populations, stock status, and habitat conditions in the Nisqually Basin (WRIA 11). Estuarine and salt-water species, or saltwater life stages of anadromous species, are not addressed. This section also addresses the Washington Dept. of Ecology's Instream Resources Protection Program (IRPP) (DOE 1988), as well as any existing instream flow studies that may have been performed in the watershed.

The Nisqually River basin contains stocks of fall chinook, winter chum, coho, pinks, winter steelhead, sockeye, bull trout and coastal cutthroat trout as well as other native and introduced fish species, about which little specific information is known. There have not been any observations of adult spring chinook spawning in this system.

CURRENT SALMONID STOCK STATUS

Currently, stocks of both hatchery and naturally produced coho, and naturally produced chinook and winter steelhead are returning in lower than expected numbers which is similar to survival patterns in other WRIAs in southern Puget Sound (Table 3-1). Because of the regional nature of the poor survival of these stocks, it has been hypothesized that the poor survival is due to unfavorable conditions in near shore areas and/or the south Puget Sound marine environments (Kerwin 1999).

STOCK STATUS AND POPULATION TRENDS

CHINOOK

Currently, the Nisqually River fall chinook is considered a mixed population of both native and hatchery origin. Their status is listed as unknown in Kerwin 1999. Chinook escapement for Nisqually River from 1970 to 1997 averaged 779 and ranged from 85 to 2332 during that period. Between 1985 and 1996, the escapement of naturally spawning fish have varied substantially. The magnitude of adult hatchery fish that contribute to the natural spawning population has not been determined. The spawning escapement estimates seem to include some hatchery strays, which could lead to overestimation of the "wild" chinook run produced by naturally spawning parents. If large numbers of hatchery strays are included in escapement estimates, the WDFW AND WWTT status designation for this population could be changed (Kerwin 1999).

The National Marine Fisheries Service (NMFS) includes the fall chinook stock population in the Puget Sound Evolutionary Significant Unit (ESU) and has listed that ESU as Threatened under the Endangered Species Act. The stock status of Nisqually River fall chinook has is still under active review by NMFS (Kerwin 1999).

Table 3-1. Nisqually River basin Salmon, Steelhead, Trout and Bull Trout - Stock Profiles as of December 1999 (Kerwin 1999).

Stock	Major Subbasin(s)	Stock Status	Stock Origin	ESA Status
Nisqually River Fall Chinook	Nisqually River Mashel River	Unknown (1)	Mixed	Threatened
Nisqually River Winter Chum	Muck Creek Nisqually River	Healthy (1)	Native	Not Warranted
Nisqually River Coho	Nisqually River Mashel River Ohop Creek	Unknown	Mixed	Candidate
Nisqually River Pink	Nisqually River Ohop Creek Mashel River	Depressed (2)	Native	Not Warranted
Nisqually River Winter Steelhead	Nisqually River Muck Creek Mashel River	Depressed (2)	Native	Not Warranted
Nisqually River Sockeye	Nisqually River Basin	Unknown (3)	Unknown	Uncertain
Nisqually River Bull Trout	Nisqually River Basin	Unknown (4)	Native	Threatened
Nisqually River Coastal Cutthroat	Nisqually River and tributaries	Presumed Healthy	Native	Not Warranted

(1) Status from WDFW AND WWTT 1994
(2) Currently this status is considered depressed by WDFW and NT (Kerwin 1999)
(3) Species not managed, see narrative.
(4) One reported bull trout juvenile has been captured in the Nisqually River basin.

COHO

Currently, the naturally spawning coho population in the Nisqually River is of mixed native and hatchery origin. Their status is listed as unknown in Kerwin 1999. Coho escapement for Nisqually River from 1972 to 1997 averaged 3,220 and ranged from 600 to 13,000 during that period. Between 1985 and 1996, the escapement of naturally spawning fish has varied from lows of less than 2,000 to highs of over 6,000 fish (Kerwin 1999). The magnitude of adult hatchery fish that contribute to the natural spawning population has not been determined. The spawning escapement estimates include hatchery strays, which may result in an overestimation of the "wild" coho run produced by naturally spawning parents. If large numbers of hatchery strays are included in the escapement estimates, the WDFW AND WWTT status designation for this population could be changed (Kerwin 19999).

CHUM

The Nisqually River chum salmon are defined as a native stock. Winter chum stocks are considered healthy (WDFW AND WWTT 1994, Kerwin 1999). Escapement estimates ranged from less than 10,000 to over 60,000 fish during the entire period from 1970 to 1995. The Nisqually winter chum stock is isolated from other Puget Sound chum stocks through geographic isolation and run timing (Kerwin 1999).

PINK

The Nisqually river pink stock returns in odd numbered years only and is considered native in origin. Population trends during the past five cycles (10 years) have shown a decrease in numbers. The WDFW AND WWTT 1994 report characterized the pink stock as healthy. However, due to the decreasing numbers, the stock is currently considered depressed by WDFW and the Nisqually Indian Tribe. During the past thirty years, Nisqually River pink salmon escapement has been highly variable, ranging from an estimated low of 500 (1981, 1983, 1985) to 12,300 (1989), no data was available for 1997 or 1999 (Kerwin 1999).

WINTER STEELHEAD

The Nisqually River winter steelhead stock is native in origin and has been showing a steady decrease in numbers since the early 1990's. Other regional stream systems had decreases in winter steelhead stocks during the same period. While many of those systems have rebounded, or in some cases stabilized, the Nisqually winter steelhead population has continued to decline (Kerwin 1999). No escapement data for Nisqually River winter steelhead is available prior to 1980. Escapement estimates are not available for 1996 due to poor water visibility (Kerwin 1999).

SOCKEYE

Sockeye salmon have been observed spawning in the mainstem Nisqually River and the Mashel River. Juvenile sockeye salmon rear in lakes. In an effort to determine the reproductive success of these sockeye, extensive sampling efforts for juvenile sockeye were completed in 1979 – 1980 at four locations in the mainstem Nisqually River (Kerwin 1999). These samples did not record any observations of sockeye rearing in the freshwater environments of the Nisqually River (Tyler 1980). One juvenile sockeye was captured in estuarine surveys of the Nisqually Delta in 1979 (Fresh et al. 1979). The origin of this juvenile fish is unknown. Thus, the reproductive success of the mainstem spawning sockeye is unknown. The glacial origin of the Nisqually River, the cold-water temperatures, and suspended sediments that interfere with plankton production make it the lakes in the basin difficult places for juvenile sockeye to rear (Kerwin 1999).

Kokanee (landlocked sockeye) have been introduced into Alder Lake. There are recorded hatchery releases in 1994, 1996 and 1997. This population reproduces naturally, primarily in the Little Nisqually River and East Creek. The adult sockeye observed spawning in the mainstem Nisqually River could be the result of these kokanee returning to their anadromous form and then returning to their natal system. Since Alder Dam does not normally spill water, returning fish would not be able to reach Alder Lake. Additionally, outmigrating juvenile fish would also have to pass through the La Grande Lake and Dam hydroelectric projects where mortality through the hydroelectric turbines and spilling is likely significant. The most likely hypothesis is that the sockeye adults observed in the Nisqually River are strays from other systems (Kerwin 1999).

BULL TROUT

The current status of Nisqually bull trout is unknown. WDFW (1998b) identifies bull trout in the Nisqually as a distinct stock based on their geographic isolation from known Puget Sound bull trout stocks and USFWS identifies the stock as threatened under the Endangered Species Act. The timing and locations of spawning are unknown. Alder Dam limits upstream passage of the anadromous form. Alder Lake provides habitat for the adfluvial life history form of this stock, although there is no documentation of bull trout in the reservoir at this time. It is currently unknown if bull trout exist above Alder Lake. Habitat in the Upper Nisqually is available and within the Mt. Rainer National Park habitat is considered excellent for bull trout (WDFW 1998b). However there have been no specific surveys for bull trout and it is unknown if the habitat is utilized.

Additional work defining the status and extent of bull trout distributions is warranted – see recommendations section later in the report.

CUTTHROAT TROUT

Both resident and anadromous forms of cutthroat trout are found in most fish bearing waters of the Nisqually River Basin from high mountain streams downstream to the Nisqually Estuary. The population status of coastal cutthroat stocks is presumed healthy for the Nisqually River Basin because they are relatively abundant in diverse habitats and multiple age classes of cutthroat are present. This species has multiple interacting life history trajectories and is managed under a species complex scenario by WDFW (Kerwin 1999).

NON-SALMONID FISH SPECIES

A variety of other native fish species may be found in the basin. Little basin-specific population information is known about these species (Table 3-2). Numerous warm water species have also been indiscriminately introduced into lowland lakes throughout the basin including largemouth bass, yellow perch, bluegill, pumpkinseed and bullheads (Cupp et al. in press). Little is known about their distribution and status, although populations appear to be small. These native and introduced species will not be discussed further.

FISH HABITAT CONDITIONS SUMMARY

This section presents descriptions of key features of the subbasins and summarizes available fish habitat information for each subbasin basin. Analyses and conclusions presented are those of the original investigators.

The most important data sources are described below. Other data sources, which generally give information for one, or a few, subbasins are presented and referenced in the appropriate sections.

- Draft Chinook Recovery Plan (Barr et al 1999).

- Salmon and Steelhead Habitat Limiting Factors Water Resource Inventory Area 11. (Kerwin 1999)

- State watershed analysis reports. Watershed analysis reports were available for Mashel River and Ohop/Tanwax/Powell sub-basins. (Cupp et al. in press).

Table 3-2. Native non-salmonid species known or suspected to be present in the Nisqually watershed or within forested ecosystems of the Pacific Northwest. (Wydoski and Whitney, 1979; WARIS/PHS database; Cupp et al. in press).

Fish Species	Scientific name
White sturgeon	*Acipenser transmontanus*
Green sturgeon	*Acipenser medirostris*
American shad	*Alosa sapidissima*
Northern pikeminnow	*Ptychocheilus oregonensis*
Three-spine stickleback	*Gasterosteus aculeatus*
Largescale sucker	*Catostomus machrocheilus*
Redside shiner	*Richardsonius balteatus*
Whitefish	*Prosopium spp.*
Reticulate sculpin	*Cottus perplexus*
Coast range sculpin	*Cottus aleuticus*
Torrent sculpin	*Cottus rhotheus*
Riffle sculpin	*Cottus golosus*
Prickly sculpin	*Cottus asper*
Pacific lamprey	*Entosphenus tridendatus*
River lamprey	*Lampetra ayresi*
Western brook lamprey	*Lampetra richardsoni*
Longnose dace	*Rhinichthys cataractae*
Speckled dace	*Rhinichthys osculus*
Redside shiner	*Richardsonius balteatus*

Problems and situations described in the reports are identified as of the date of the survey. The types and severity of habitat impacts varies between subbasins within the Nisqually Basin. However overall, habitat conditions in the Nisqually Basin are degraded relative to the estimated historic condition (Barr et al. 1999).

One of the key features of Nisqually River tributaries that are accessible to anadromous fish are the two different geologic areas which have distinct patterns of flow, land use and in-stream habitat. Section 2.0 provides a comprehensive overview of the geology and land use in the WIRA. This section refers to 'prairie', 'spring fed' and 'upper tributary' type streams. It is important to understand the gross distinctions between these. 'Prairie' systems are usually lower tributaries that drain prairie areas with gravelly soils of glacial origin. The land use in these areas is typically farming, rural residential, and some timber management. These streams have relatively flat gradients and very low summer flow, often becoming intermittent. The second geologic areas can be characterized as 'spring fed' these areas typically occur in lower reaches of the stream systems where the streams cut through the bluff bordering the main Nisqually are supplemented by springs and often have year round flow even when the upper reaches are dry (Walter 1986). 'Upper tributaries' (Ohop Creek & above) drain low mountainous areas and have steeper gradients. These areas have some winter snowpack and generally better summer flows. The land use is almost exclusively timber (Walter 1986).

SUBBASIN SUMMARIES: SURFACE WATER DESCRIPTIONS & HABITAT QUALITY IN THE LOWER NISQUALLY BASIN

The surface water flow patterns and habitat conditions in all subbasins in the Nisqually are discussed below. Maps showing the reach boundaries and key geographic features are located in chapter 2.0. Details regarding habitat conditions and factors limiting fish production are provided in Table 3-4.

McAllister

McAllister Creek drains directly into the estuary and supports coho, chum, sockeye, winter steelhead, chinook and possibly a few pink salmon (Thurston County 1993). The streams are primarily spring fed, with a salt wedge extending up to between River Mile (RM) 3.8 to 4.5 (AGI et al. 1999, Barr et al. 1999). Tidal influence extends to RM 5.5 (the uppermost portion of the creek). The stream channels are generally low gradient, originating in moderately timbered slopes with agriculture in the valley area. The largest spring is developed by the city of Olympia for drinking water. Spawning is limited to the upper reaches due to peat and fine sediment in the lower stream as well as the presence of the salt wedge.

There is a WDFW Fish Hatchery near the Steilacoom road crossing. The hatchery produces chinook salmon. Disease and parasite problems prevented the hatchery from operating at full capacity (Thurston County 1993).

There are impassable road-crossing barriers on Eaton Creek at Yelm Highway and Evergreen Valley Road preventing adult upstream passage (Thurston County 1993). The barrier at Yelm Highway is potentially limiting kokanee access to the upstream lake.

Habitat impacts include dikes and armoring at road crossings that limit channel migration and off channel rearing habitat.

Mainstem Nisqually

The Nisqually / McAllister Creek estuary extends downstream from approximately I-5 to Puget Sound. The dominant feature of the reach is the tidal mudflats and salt marsh. Although the Nisqually estuary is the largest in southern Puget Sound it has been reduced by approximately 30% through the construction of dikes. The portion west of the Nisqually River is within the Nisqually National Wildlife Refuge. The area east of the River is currently being acquired for protection. A project in 1995 by the Nisqually Tribe reclaimed 8.5 acres of estuarine habitat on the right bank. In the lowest part of this reach, the river meanders freely over its estuarine flood plain. There are a substantial number of bank protection dikes along the middle part of this reach, originally created to convert salt marsh to pasture, which limit lateral migration of the channel. Riparian forests are confined primarily to a narrow corridor along the mainstem.

This estuary is an important rearing habitat for all salmonid species. Tidal influence is characteristically large, with full volume water replacement every 8 days.

Lower Nisqually Mainstem from RM 2.4 to RM 12.7 supports populations of all salmonid species. There is tidal influence up to approximately the Santa Fe Railroad bridge. The reach below the City of Centralia has powerhouse penstocks at RM 12.7 (see section 2.0 for a description of water diversions and dams). The reach from RM 4.5 to 12.7 is the least impacted section in this portion of basin. Significant bank armoring has been constructed along the lower left bank between RM 2.4 and RM 4.5, especially near highway and railroad bridges. Between RM 4.5 to 12.7 the mainstem Nisqually meanders freely with important wall based side channels; chum spawning, and overwintering of coho & steelhead. The Nisqually Tribe's Clear Creek hatchery is located on the right bank at RM 6.1, and the Tribe’s Kalama Creek hatchery is located on an abandoned side channel of the river at approximately RM 9.5. This is the only reach in the system with good LWD.

The Middle Nisqually from RM 12.7 to 26.2 includes the Mainstem Diversion Reach” or “McKenna Diversion”. All salmonid species pass through this section of river and chum, coho, chinook and steelhead spawn in this reach. There are spawning gravels in the lower two miles. From RM 12.7 to 19.0 the river is shallow, and runs through a narrow canyon. It has a steep gradient channel bordered by prairie habitats. Housing developments limit riparian conditions in some locations. Flood control dikes have been installed near RM 21.8.

The Centralia Diversion Dam has fish ladder. The Diversion Canal was screened in 1999 to prevent fish from passing into the canal. There is limited quantitative data on this reach and unverified concerns about fine sediments. Good to fair conditions otherwise appear to pertain. No LWD data is available, but it is probably good in the Fort Lewis section and low elsewhere.

The Upper Nisqually Mainstem from RM 26.2 to 42.5 is a transport corridor for all species, and spawning ground for chum, coho, chinook and steelhead. Flood control dikes have been constructed in lower left bank of this reach. Along the lower reach the land has been developed for residential and agricultural use. A large right bank landslide occurred historically downstream of Ohop Creek (200- 300,000 cubic yards). Upstream of Ohop Creek, deep pools form between narrow bedrock cliffs. Quantitative data is available for this reach and show good conditions for all habitat parameters except LWD, which was rated as poor.

Two hydroelectric projects interrupt the Nisqually Mainstem in this area. The city of Tacoma's Nisqually Project started in 1910 and expanded in 1942. The LaGrande and Alder Dams were built as part of this project. These dams intercept all spawning sized gravels and large woody debris (LWD) from upper basin.

Subbasin summary: The mainstem of the Nisqually River provides migration habitat for all the salmonid species in the basin, spawning habitat for chum, coho, chinook and steelhead, and rearing habitat for most of the salmonids in the basin. As such, the mainstem habitats are arguably the most important habitat in the basin. The mainstem generally has good habitat. LWD may be sub-optimum in the upper and some of the middle reaches.

Mashel

The Mashel River is the largest tributary accessible to salmonids in the basin. It drains an area of 83 square miles; there are 20 miles of the mainstem Mashel River and 67 miles of tributary streams. Upper reaches have a steep gradient and pass through a narrow canyon where timber is produced commercially. Downstream of Busywild Creek, the gradient is moderately steep. The substrate is composed of mostly cobbles and small boulders with small gravel pockets. Coho, chinook, pink, steelhead and cutthroat populations are supported in this subbasin. The Mashel River is riprapped and channelized near Eatonville, between RM 5.1 and RM 6.0. Upstream of RM 6.6, the river banks are unstable and failing in places. Low quantities of LWD exist along the river. Young second growth limits future LWD recruitment to the river and provides limited shade.

The Little Mashel joins the mainstem Mashel River at RM 4.4. A waterfall at RM 0.8 is impassable. The Little Mashel passes hobby farms, and rural residential areas. A cobble/boulder substrate with some gravel patches is present in some area. Coho, steelhead and cutthroat populations are supported here. Habitat conditions are generally good but fish use is limited.

Beaver Creek enters the mainstem Mashel at RM 9.3. An impassable cascade at 0.5 miles limits fish access in upper reaches of the creek. A fish ladder was installed in the 1980s, but its status is unknown. The upper reaches of Beaver Creek flow through commercial timberlands, a series of wetlands, and into a broad valley. It flows through a narrow canyon between RM 2.0 and RM 0.5 at which point the gradient decreases. Beaver Creek has a boulder substrate with small gravel patches. Coho, steelhead and cutthroat trout populations are sustained in the creek. Young second growth along the stream channel limits future LWD recruitment and provides limited shade.

The upper reaches of Busywild Creek flow though WDNR land and commercial timberland (Campbell Group). A cascade that is impassable for fish is located at RM 5.0. The majority of the reach flows through a fairly steep, narrow, confined canyon, but the lower 2 miles flow along a broader hanging valley floor. The lowest 0.5 miles of the stream passes through a canyon and has a steep gradient. Coho, steelhead, and cutthroat trout populations are sustained in Busywild Creek. Young second growth along the banks of the creek limit future LWD recruitment and provides limited shade.

Subbasin summary: The Mashel River subbasin appears to have limited spawning habitat. Fish primarily spawn in gravels, however, much of the river is too steep to allow for the accumulation of gravels of suitable size. The upper portion of the basin lies in a steep canyon where spawning size material would not be expected to collect in abundance. The lower portion of the mainstem (below river mile 6.0) has a more moderate gradient and contains good amounts of spawning substrate. This is particularly true below river mile 3.2, where much of the salmon spawning in recent years has been observed (Nisqually Tribe 2001, draft report comments). Habitat is also affected by the availability of LWD, which is limited in most portions of this subbasin.

Muck / Murray

The Muck/Murray subbasin has five major tributaries including Red Salmon Creek, Clear Creek, Muck Creek, Murray Creek, and Horn Creek - the outlet for Harts Lake.

Red Salmon Creek drains directly into the estuary and supports runs of coho, chum, steelhead, and sea-run cutthroat. Tidal influence extends upstream to RM 1.2 with a salt wedge also extending to RM 1.2. The stream is spring fed and originates in moderately timbered slopes with agriculture in the lower valley area. There is limited quantitative data for this stream. However, professional judgment by Technical Advisory Group (TAG) members indicates overall fair to good habitat conditions with LWD and side channel habitat considered poor (Barr 1999).

Clear Creek is a small tributary to the main Nisqually. It is a wall based spring fed stream that joins the Nisqually at RM 6.1. Historically the creek provided about 1.1 miles of usable habitat. Currently there is a Salmon Hatchery for chinook and coho present on Clear Creek. Adult salmon traps for returning broodstock restrict upstream migration above RM 0.1. There is limited data on habitat conditions although they appear variable with low LWD, limited side channel habitat, high fines, and poor riparian conditions.

Muck Creek is the most significant tributary to the lower Nisqually. This system has seven major tributaries, containing 50 miles of habitat that support runs of chum, winter steelhead and sea run cutthroat. It is characteristic of prairie type stream systems, which are spring fed and have lower gradients. The lower seven miles of Muck Creek passes through Fort Lewis and has intact riparian conditions. Muck Creek has two larger tributaries, Lacamas and South Creeks, as well as other named and unnamed short feeder streams (i.e.: Exeter Springs, Johnson Marsh) that contribute flow and natural production opportunities. Thick growth of invasive reed canary grass has been identified as a problem although specific areas of concern need to be identified.

Murray Creek is also characteristic of a spring fed, low gradient prairie based system. It supports runs of chum, winter steelhead and sea-run cutthroat. The lower portion of the creek maintains stable surface flow in early summer, which provides important rearing habitat and/or high flow refuge. Flows become intermittent above RM 0.6 preventing upstream migration in summer and early fall. There is a commercial gravel mining operation along this creek. There is no quantitative habitat data although it is felt that the quantity of LWD and pools is poor. There are indications of increased sedimentation and increased channel migration, although no source has been identified. Fish access is reportedly limited by beaver dams at times.

The Horn Creek/Harts Lake outlet is characteristic of a spring fed, low gradient prairie based system, with some local incision near the confluence with the mainstem Nisqually. This tributary supports populations of coho, chum, steelhead and cutthroat. Juvenile chinook may use this area for rearing or refuge. The stream is associated with wetland complexes and lakes. In 1976, Harts Lake Creek changed course and now flows into Horn Creek. At RM 1.0 there is a barrier of concrete and boulders where a fish ladder was installed in 1997. Water withdrawals impact summer flows. Although there is limited quantitative data on habitat conditions, there appear to be a large amount of fine sediment downstream of RM 0.4 where the stream gradient is flat.

Subbasin Summary: Muck Creek is the most significant tributary in the lower Nisqually in terms of fish habitat. Habitat quality is generally good although invasions of reed canary grass threaten some areas – specific problem areas need to be identified. The extent of the invasion is unknown. Other tributaries are generally considered to have low LWD and poor side channel habitat.

Tanwax / Kreger / Lower Ohop

Tanwax Creek is characteristic of a spring fed, low gradient, prairie based system with some local incision near the confluence with the mainstem Nisqually. Coho, steelhead, and cutthroat populations are supported by the stream. Juvenile chinook may use Tanwax Creek for rearing or refuge. The stream is associated with wetland complexes and lakes. Historically, Tanwax Creek was 13.3 miles long. Intense recreation and fishing pressure has impacted stream conditions. Above RM 6.5 riparian conditions are poor. Below this level, wetlands have been invaded by reed canary grass. Beaver dams limit access in various parts of the stream. Additional investigation is warranted to understand the impact of docks (overwater structures) in Tanwax Lake on fish populations.

Kreger Lake Outlet Creek supports populations of coho, steelhead, and cutthroat trout. Juvenile chinook may use it for rearing or refuge. It is characteristic of a spring fed, low gradient, prairie based system with some local incision near the confluence with the mainstem Nisqually. Kreger Lake Outlet Creek is associated with wetland complexes and lakes, and originates at Silver Lake. Upstream access limited by beaver dams in the wetland complex at RM 1.1.

Lower Ohop Creek is home to populations of coho, chinook, pink, winter steelhead and coastal cutthroat. It is the 3rd largest anadromous fish accessible tributary in the basin. The dominant feature of this system is Ohop Lake that has relatively dense residential development around it. Downstream of RM 0.3, limited hardwood riparian conditions exist. From RM 0.3 to 4.5 the creek is channelized with sand and silt substrate, and no intact natural riparian conditions. A log weir at the lake may delay upstream migration. In 1889, 30 % of the stream flow was diverted into the Puyallup Basin to protect the lower Ohop Valley from flooding. The low stream gradient contributes to high sediment concentrations. All spawning locations contain greater than 17% fines. Instream LWD is low, water temperature is high, and DO is low throughout.

Lynch Creek joins Ohop Creek at RM 6.2. It flows through timberlands (Weyerhaeuser and Campbell Group), rural residential areas, and hobby farms along the lower mile. The town of Eatonville discharges its stormwater collection into the creek, contributing a sediment load equal to 17% over background values (Denman 1998). Natural falls at RM 1.0 block upstream fish access, and the gradient in the lower reach of the creek is steep with limited spawning. Coho, chinook, pink, winter steelhead and coastal cutthroat reside in Lynch Creek.

Twenty-five Mile Creek joins Ohop at RM 9.9. It flows through timberlands, past a recently abandoned clay mine, and through an area of rural residences and hobby farms. Coho, chinook, pink, winter steelhead and coastal cutthroat populations are sustained in Twenty-five Mile Creek. A natural impassable barrier sits at RM 1.0. The substrate contains mean fines of 18 to 19%. Fine-grained soils and land management add 26% fines over background values (Denman, 1998).

Subbasin summary: Lower Ohop Creek is the third largest tributary in the basin that is accessible to anadromous salmonids. In general, habitat appears to have low quantities of LWD, high quantities of fine sediment in spawning gravels, and poor riparian conditions (at least along the lower portions of the creek).

Tanwax Creek also has the potential to provide significant fish habitat. Currently it supports a number of salmonid species. Riparian conditions are poor in most of the lower river and wetlands have been invaded by reed canary grass.

Yelm

Kalama Creek is a small wall based spring fed tributary that joins the mainstem Nisqually at RM 9.1. Historically the stream was about 1.5 miles long. Currently a chinook and coho hatchery is located at RM 0.51. The hatchery traps returning adult salmon; hence, migration past these traps is limited to fish passed upstream by the hatchery. There is limited quantitative data on habitat conditions. It appears the stream has poor LWD, infrequent side channels, and reduced connectivity, but that other habitat parameters are good.

Yelm Creek is characteristic of spring fed, low gradient prairie based systems. The stream maintains populations of chum, winter steelhead and sea run cutthroat. Coho and chinook have also been observed in the lower 0.4 miles of the creek (Tetra Tech/KCM 2001). A natural barrier to upstream fish passage is located at river mille 0.4.

There is no data on substrate for most of Yelm Creek but there is an unverified concern about fines. The history of LWD removal has probably created poor LWD conditions. Riparian conditions are impacted by development.

The habitat of Yelm Creek in and around the City of Yelm has been documented in the Yelm Creek Comprehensive Flood Hazard Management Plan (Tetra Tech/KCM 2001). This document indicates the lower portion of the creek goes dry in late summer and early fall. Habitat conditions are poor. Riparian vegetation is dominated by reed canary grass and nightshade, except in areas that are accessible to livestock. In those areas, the invasive species are uncommon, but the banks have been trampled. Substrate near the Centralia Power canal flume is clean gravel. Upstream of this area, substrate is covered heavily with silt. The presence of the invasive species aggravates the sediment situation by retaining fine sediment.

Toboton / Powell / Lackamas

Lackamas Creek is characteristic of a spring-fed, low-gradient, prairie-based system with some local incision near the confluence with the mainstem Nisqually. The stream maintains populations of coho, steelhead and cutthroat trout. Juvenile chinook may use Lackamas Creek for rearing or refuge. This creek is also associated with wetland complexes. At 3.0 miles, Lackamas creek drains Bald Hills. Intermittent summer flows and beaver dams on the creek may block fish access.

The Toboton Creek is characteristic of a spring fed, low gradient prairie based system, with some local incision near the confluence with the mainstem Nisqually. This tributary is also associated with wetland complexes and lakes. It supports populations of coho, steelhead and cutthroat. Juvenile chinook may use this tributary for rearing or refuge. There is no water quality data for this creek. Toboton Creek Tributary has low LWD and poor riparian conditions, with the highest road density in this subbasin (a distinction shared by Powell Creek) – though these are mostly older roads and are not a major sediment concern (Denman 1998). Intermittent summer flows limit fish access.

Powell Creek is characteristic of a spring fed, low gradient, prairie based system with some local incision near the confluence with the mainstem Nisqually. It is associated with wetland complexes and lakes. Populations of coho, steelhead, and cutthroat trout are supported by this stream, and juvenile chinook may use it for rearing or refuge. Commercial timber production occurs along this creek. There is a barrier, which is impassable by fish at RM 2.2. Powell Creek has low LWD and poor riparian conditions along with the highest road density in the subbasin (a distinction shared by the Toboton Creek) – though these are mostly older roads and are not a major sediment concern (Denman 1998). Inadequate recruitment of LWD limits the use of this creek by fish and there is an unverified concern regarding the temperature of the creek water. Beavers occasionally dam the creek, limiting fish access to upper reaches.

Upper Basin

The Upper Basin (from RM 42.5 to the headwaters) contains no anadromous fish access, however, it influences downstream flow, sediment load and LWD supply. LaGrande Lake is a naturally occurring lake within a steep walled canyon. It is believed that it had a natural falls that limited passage, but this is not documented.

IMPASSABLE CULVERTS

Culverts can block fish passage to important habitat areas regardless of in-stream conditions. There is one identified impassable culvert in the anadromous portion of the Basin listed by Kerwin 1999 from G. Walters (personal comm.). The WDFW culvert database also lists four impassable culverts, all outside the anadromous fish zone. A comprehensive inventory of culverts on private and country roads that are impassable to resident fish species has not been completed.

Table 3-3. Summary of Subbasin Conditions in the Nisqually Basin (Kerwin 1999, unless otherwise noted)

Subbasin	Tributaries	Species	Notable Features	Habitat Conditions
Main Stem				
	Nisqually Estuary (RM 0.0 to 2.4)	Rearing habitat for all salmonid species	Extensive diking for bottomland conversion. Tidal influence – water replaced every 8 days.	
	Lower Nisqually Mainstem (RM 2.4 to RM 12.7)	All Species pass through and may rear for some time. Chum spawning. Coho and steelhead overwintering.	Tidal influence to RM 3.7. Reach below City of Centralia penstocks (RM 12.7). Significant bank armoring along lower left bank (RM 2.4 to 4.5) near highway & railroad bridges. RM 4.5 to 12.7 meanders freely with important wall based side channels.	RM 4.5 to 12.7 least impacted reach in this portion of basin. Only reach in system with good LWD.
	Middle Nisqually (RM 12.7 to 26.2)	All species pass through. Chum, coho, chinook & steelhead spawn.	Mainstem Diversion Reach" or "McKenna Diversion" From RM 12.7 to 19.0 shallow narrow canyon with steep gradient channel, bordered by prairie habitats. Flood Control dikes near RM 21.8. More spawning gravels in lower two miles. Centralia Diversion Dam has fish ladder. Diversion Canal screens updated in 1999.	Limited quantitative data, unverified concerns about fine sediments, good and fair conditions otherwise. Housing developments limit riparian conditions in some locations. No LWD data; probably good on Ft Lewis and low elsewhere.
	Upper Nisqually Mainstem (RM 26.2 to 42.5)	Transport corridor for all species, spawning for chum, coho, chinook & steelhead	Flood control dikes in lower left bank. Rural residential & agricultural development along lower reach. Large right bank landslide downstream of Ohop Creek (200- 300,000 cubic yards). Upstream of Ohop Creek deep pools between narrow bedrock cliffs. Old wood bridge above Mashel falling into river. Two hydroelectric projects. The city of Tacoma's Nisqually Project (La Grand Dam and Alder Dam) started in 1910 and expanded in 1942.	Quantitative data available, Good conditions for all habitat parameters except LWD, which was rated as poor. Hydroelectric projects intercept all spawning sized gravels and LWD from upper basin.
McAllister				
	McAllister	Chinook, coho, steelhead, sockeye, sea-run cutthroat	Spring fed, salt wedge RM 3.8 to 4.5, tidal influence to 5.5 (headwaters). Originate in moderately timbered slopes with agriculture in valley area. Low gradient. Hatchery for chinook – disease and parasites limit production.	Dikes, armoring at road crossings limit channel migration & off channel rearing habitat. Largest spring developed by City of Olympia for drinking water.
Muck/Murray				
	Red Salmon	Coho, chum, steelhead, sea-run cutthroat	Salt wedge to RM 1.2, tidal influence to RM 1.2. Spring fed. Originate in moderately timbered slopes with agriculture in valley area.	Limited quantitative data. Professional judgment indicates fair to good habitat conditions. LWD & side channel habitat considered poor.

Subbasin	Tributaries	Species	Notable Features	Habitat Conditions
	Clear Creek	Salmon Hatchery – Chinook & coho.	Small trib to mainstem. Wall based spring fed stream. Joins Nisqually at RM 6.1. Mainstem historically about 1.1 miles.	Adult salmon traps for returning broodstock limits upstream migrations above 0.1 miles. Habitat conditions variable – limited data low LWD, limited side channel habitat, high fines and poor riparian.
	Muck Creek	Chum, winter steelhead and sea run cutthroat.	Most significant tributary in lower Nisqually. 7 tributaries, 50 miles of habitat. Characteristic of prairie based system, spring fed, low gradient. Lower 7 miles on Ft Lewis intact riparian. Has two larger tributaries, Lackamas and South Creeks along with other named and unnamed short feeder streams (i.e.: Exeter Springs, Johnson Marsh) contribute flow and natural production opportunities.	Intermittent flows (Nisqually tribe comments 2001). Invasive reed canary grass – specific problem areas need identification.
	Murray Creek	Chum, winter steelhead and sea run cutthroat.	Characteristic of prairie based system, spring fed, low gradient. Maintain stable surface flow in early summer – important rearing and/ or high flow refuge. Commercial gravel mining operation.	No quantitative data. Poor LWD, pools and unverified substrate. Increased sedimentation, increased channel migration, no source identified. Fish access may be limited at times by beaver dams. Flows become intermittent above RM 0.6 preventing upstream migration.
	Horn Creek/ Harts Lake outlet	Coho, chum, steelhead & cutthroat. Juvenile Chinook may use for rearing or refuge.	Characteristic of prairie based system, spring fed, low gradient some local incision near confluence with Nisqually. Associated with wetland complexes and lakes. 1976 Harts Lake Creek changed course and now flows into Horn Creek.	Water withdrawals impact summer flows. Limited quantitative data. Downstream of RM .4 flat stream gradient with high fine sediments. RM 1.0 barrier of concrete and boulders – fish ladder installed in 1997.
Yelm				
	Kalama Creek	Salmon Hatchery – Chinook & coho.	Small trib to mainstem. Wall based spring fed stream. Joins Nisqually at RM 9.1. Historically about 1.5 miles long.	Adult salmon traps for returning broodstock limits upstream migrations above 0.51 miles. Habitat conditions variable- limited quantitative data. Poor LWD, side channels, connectivity, other parameters good.
	Yelm Creek	Chum, coho, winter steelhead and sea run cutthroat.	Characteristic of prairie based system, spring fed, low gradient. Maintain stable surface flow in early summer – important rearing and/ or high flow refuge in the lower 0.4 mile of the creek.	No data on substrate in upper portion of basin, however there is an unverified concern about fines. Lower portion of the creek has very high fines. History of LWD removal probably created poor LWD conditions. Riparian impacted by development. Habitat conditions in and around the City of Yelm generally degraded. A natural passage barrier exists at river mile 0.4.

Subbasin	Tributaries	Species	Notable Features	Habitat Conditions
Toboton/ Powell/ Lackamas				
	Lackamas Creek	Coho, steelhead & cutthroat. Juvenile Chinook may use for rearing or refuge.	Characteristic of prairie based system, spring fed, low gradient some local incision near confluence with Nisqually. Associated with wetland complexes. 3.0 miles draining Bald Hills.	Intermittent summer flows. Beaver dams occasionally block access.
	Toboton Creek	Coho, steelhead & cutthroat. Juvenile Chinook may use for rearing or refuge.	Characteristic of prairie based system, spring fed, low gradient some local incision near confluence with Nisqually. Associated with wetland complexes and lakes.	No water quality data. Poor LWD, riparian, highest road density in subbasin – mostly older roads, not major sediment concern (Denman 1998). Intermittent summer flows.
	Powell Creek	Coho, steelhead & cutthroat. Juvenile Chinook may use for rearing or refuge.	Characteristic of prairie based system, spring fed, low gradient some local incision near confluence with Nisqually. Associated with wetland complexes and lakes. Commercial timber.	Poor LWD, riparian, highest road density in subbasin – mostly older roads, not a major sediment concern (Denman 1998). Inadequate riparian recruitment. Potential temperature concern. Beavers may limit access. Impassable barrier RM 2.2.
Tanwax/ Kreger/ Lower Ohop				
	Tanwax Creek	Coho, steelhead & cutthroat. Juvenile Chinook may use for rearing or refuge.	Characteristic of prairie based system, sp ring fed, low gradient some local incision near confluence with Nisqually. Associated with wetland complexes & lakes. 13.3 miles of stream. Intense recreation and fishing pressure.	Above RM 6.5 poor riparian. Wetlands invaded by reed canary grass. Beaver dams may limit access. Impacts of docks (overwater structures) need additional investigation.
	Kreger Lake Outlet Creek	Coho, steelhead & cutthroat. Juvenile Chinook may use for rearing or refuge.	Characteristic of prairie based system, spring fed, low gradient some local incision near confluence with Nisqually. Associated with wetland complexes and lakes. Originates at Silver Lake.	Upstream access may be limited by beaver dams in wetland complex at RM 1.1. (See Tanwax description)
	Lower Ohop Creek	Coho, chinook, pink, winter steelhead and coastal cutthroat.	3rd largest anadromous fish accessible tributary. Dominant feature is Ohop Lake with relatively dense residential development. Below RM 0.3 limited hardwood riparian. RM 0.3 to 4.5 channelized with sand & silt substrate, no intact natural riparian. Log weir at lake may delay upstream migration. 1889 30 % of flows diverted into Puyallup Basin to protect lower Ohop Valley from flooding. Low gradient = high sediment.	All spawning locations > 17% fines. Instream LWD low, high temps, low DO.

Subbasin	Tributaries	Species	Notable Features	Habitat Conditions
Mashel/ Lynch / Twenty-five Mile				
	Lynch Creek	Coho, chinook, pink, winter steelhead and coastal cutthroat.	Joins Ohop at RM 6.2. Flows through timberlands (Weyerhaeuser and Campbell Group), rural residential & hobby farms along lower mile. Eatonville stormwater collection discharges into creek.	Sediment from storm water system = 17% over background (Denman 1998). Natural falls at RM 1.0 block upstream access, gradient in lower reach steep with limited spawning.
	Twenty-five Mile Creek	Coho, chinook, pink, winter steelhead and coastal cutthroat.	Joins Ohop at RM 9.9. Flows through timberlands, recently abandoned clay mine, rural residential & hobby farms.	Natural impassable barrier at RM 1.0. Mean fines 18 & 19 %. Fine-grained soils land management adds 26% over background (Denman).
	Mashel River	Coho, chinook, pink, steelhead & cutthroat.	Largest tributary accessible to salmonids. 83 sq miles. 20 miles mainstem, 67 miles streams. Upper reaches steep gradient narrow canyon, commercial timber. Downstream of Busywild moderately steep, cobble, small boulder with small gravel pockets.	Rip rapped and channelized near Eatonville RM 5.1 to 6.0. Upstream of RM 6.6 unstable banks, mass wasting, low LWD. Young second growth limit LWD recruitment, shade.
	Little Mashel	Coho, steelhead & cutthroat.	Joins Mashel at RM 4.4. Hobby farms, rural residential. Cobble/ boulder substrate with some gravel patches.	Impassable waterfall at .8 miles. Habitat conditions generally good. Fish use limited.
	Beaver Creek	Coho, steelhead & cutthroat.	Enters Mashel at RM 9.3. Commercial timberlands. Series of wetlands in broad valley to RM 2.0 enters narrow canyon to .5 where gradient decreases boulder substrate with small gravel patches.	Impassable cascade at 0.5 miles. Fish ladder installed in 1980's status unknown. Young second growth limit LWD recruitment, shade.
	Busywild Creek	Coho, steelhead & cutthroat.	WDNR and Campbell Group commercial timber. Fairly steep narrow confined canyon, lower 2 miles broader hanging valley floor, lowest 0.5 miles steep gradient canyon.	Young second growth limit LWD recruitment, shade. Impassable cascade at RM 5.0.
Upper Basin (RM 42.5 - Headwaters)				
		No Anadromous Fish Access	The reach influences downstream flow, sediment & LWD. La Grande Lake is a naturally occurring steep walled canyon.	It is believed that had a natural falls that limited passage – but not documented.

INSTREAM FLOWS

In this watershed, two instream flow situations were found. The first are "instream flows" that were adopted into state rules by the Department of Ecology. These flows are not based on field studies and may include flows that are not necessarily observed in the stream under current conditions or historical conditions. In the water right hierarchy, the date of the instream flows' adoption into the rule is its seniority. Thus, only water rights issued after the date of the instream flow rule's adoption are subject to the restrictions of the instream flow, or to administrative closure to additional water withdrawal. Because of this, in many basins with senior water rights, a junior instream flow may not be observed often, or during all seasons. In the Nisqually watershed, instream flows and administrative closures date back to 1944, although the adoption of the IRPP flows and closures was in 1988 (Tables 3-4 and 3-5).

In addition, a "minimum flow" agreement, negotiated between 1976 and 1993 as part of a Federal Energy Regulatory Commission (FERC) proceeding, is in place for the Nisqually River mainstem between River Mile (RM) 40.7 and 12.7, and is described below. This differs from an IRPP instream flow in that

- The flows are based on instream studies,
- The flows described in the agreement can actually be provided in the river most of the time (62 FERC 63,032), and
- The specified flows are a condition on existing (senior) water rights held by Centralia City Light and Tacoma Public Utilities (?).

WASHINGTON DEPT. OF ECOLOGY INSTREAM RESOURCES PROTECTION PROGRAM (IRPP), WRIA 11 (173-511 WAC).

The Department of Ecology, under the Water Resources Management Program (WAC 173-500) is authorized, among other things, to "...establish flows on perennial streams of the state in amounts necessary to provide for preservation of wildlife, fish, scenic, aesthetic, and other environmental values, and navigational values..." and "...set forth streams closed to further appropriation" (Ecology 2000). Instream flow recommendations become instream flows when they are adopted as administrative rules. The seniority of instream flow rules with respect to water right is the date of their adoption; they do not supercede senior water rights but rather condition those junior (Table 3-4). Older closures to additional appropriation were also included in the regulations (Table 3-5).

Table 3-4. Streams closed to further allocation by Washington Dept. of Ecology (seniority of closure is 1988) (WAC 173-511).

Stream	Tributary to	Period of closure
Mashel River & tributaries	Nisqually River	June 1- October 31
Red Salmon Creek (Mounts Creek) & tributaries	Nisqually River	April 1 - October 31
Clear Creek & tributaries	Nisqually River	April 1 - October 31
Tanwax Creek & tributaries	Nisqually River	April 1 - October 31
McAllister Creek & tributaries, except Medicine Creek	Puget Sound	All year
Lake Saint Clair		All year
Toboton Creek & tributaries	Nisqually River	April 1- November 30
Lackamas Creek & tributaries	Nisqually River	April 1 - November 30
Murray Creek	Nisqually River	April 1 - November 30
Bypass Reach, Nisqually River	Puget Sound	June 1 - October 31
Mid Reach, Nisqually River	Puget Sound	June 1 - October 31

(source: WAC 173-511)

Table 3-5. Stream and lake instream flows and administrative closures, existing in 1988 and confirmed by the Dept. of Ecology (WAC 173-511).

Stream	Tributary to	Action	Dates
Eaton Creek	Lake Saint Clair	Closure	December 1953
Harts Lake & outlet streams	Nisqually River	Low flow (0.5 cfs)	October 1944
Horn Creek	Nisqually River	Closure	July 1974
Muck Creek & tributaries	Nisqually River	Closure	May 1948
Ohop Creek & tributaries	Nisqually River	Closure	February 1952
Ohop Lake	Ohop Creek	Lake level (523 feet)	March 1966
Thompson Creek & tributaries	Nisqually River	Low flow (1.0 cfs)	November 1951
Unnamed stream & tributaries (Sec. 11, T15N, R4E)	Alder Lake	Closure	April 1964
Unnamed stream & tributaries (sec. 17, T17N, R2E)	Centralia Canal	Low flow (0.75 cfs)	November 1951
Unnamed stream & tributaries (Sec. 27, T17N, R2E)	Nisqually River	Low flow (0.5 cfs)	December 1950
Yelm Creek & tributaries	Nisqually River	Closure	August 1951

(Source: WAC 173-511)

The IRPP instream flows are set at three control points on the Nisqually River, and one point on the Mashel River. These are described moving upstream from the mouth of the river. The "Nisqually River Lower Reach" control point is at river mile (RM) 4.3, with the affected stream reach from the influence of mean annual high tide at low flow (base flow) levels to the outlet of the Centralia City Light power plant at RM 12.7. These instream flows range from 600 to 900 cfs (Table 3-6). The "Nisqually River Bypass Reach" control point is at RM 21.8 (USGS gage

12-0895-00), with the affected stream reach from the power plant outlet at RM 12.6 to the Centralia City Light power canal diversion at RM 26.2, including all tributaries. These instream flows range from 370 to 600 cfs, with a closure from June 1 - October 30 (Table 3-6).

The "Nisqually River Mid Reach" control point is at RM 32.6 (USGS gage 12-0884-00), with the affected reach from the power canal diversion at RM 26.2 to the stream gage at RM 57.8, near the La Grande power plant (USGS gage 12-0825-00). These instream flows range from 600 to 900 cfs, with a closure from June 1 - October 31 (Table 3-6).

The "Nisqually River Upper Reach" control point is at RM 57.8, with the affected reach from USGS gage 12-0822-00 upstream to the headwaters, including all tributaries. These instream flows range from 300 to 650 cfs (Table 3-6).

The Mashel River control point is at RM 3.25 (USGS gage 12-0870-00), with the affected reach from the mouth upstream to the headwaters, including all tributaries. These instream flows range from 20 to 100 cfs, with a closure from June 1 through October 31 (Table 3-6) (WAC 173-511).

Table 3-6. Instream flows set for the Nisqually River basin under Dept. of Ecology Instream Resources Protection Program (WAC 173-511). Flows in cubic feet per second (cfs). (C) Indicates months closed to additional appropriation.

Month	Day	Lower Reach Nisqually River RM 4.3	Bypass Reach Nisqually River RM 21.8	Mid Reach Nisqually River RM 32.6	Upper Reach Nisqually River RM 57.8	Mashel River RM 3.25
January	ALL	900	600	900	450	100
February	ALL	900	600	900	450	100
March	ALL	900	600	900	450	100
April	ALL	900	600	900	450	100
May	1	900	600	900	450	100
	15	900	600	900	450	80
June	1	900	500 (C)	800 (C)	600	80 (C)
	15	850	450 (C)	800 (C)	650	70 (C)
July	1	800	400 (C)	800 (C)	550	50 (C)
	15	800	400 (C)	800 (C)	500	40 (C)
August	1	800	370 (C)	800 (C)	450	30 (C)
	15	800	370 (C)	650 (C)	400	30 (C)
September	1	600	370 (C)	600 (C)	350	20 (C)
	15	600	370 (C)	600 (C)	300	20 (C)
October	ALL	700	550 (C)	700 (C)	300	20 (C)
November	1	700	600	700	350	40
	15	700	600	700	400	70
December	1	800	600	800	450	100
	15	900	600	900	450	100

THE NISQUALLY RIVER COORDINATING COMMITTEE (NRCC)

A "minimum flow" agreement, negotiated between 1976 and 1993 as part of a Federal Energy Regulatory Commission (FERC) proceeding, is in place for the Nisqually River mainstem between River Mile (RM) 40.7 (La Grande powerhouse) and RM 12.7 (City of Centralia powerhouse). The FERC proceeding started in 1976, eventually including the Nisqually Tribe, Tacoma Public Utilities, the Puyallup Tribe (who withdrew in 1982), Centralia City Light, and Washington Departments of Fish and Wildlife.

Instream flow studies were conducted, and recommendations for instream flows and operation of both the Tacoma and Centralia facilities were developed by the NRCC. In 1989, Tacoma Public Utilities committed to provide instream flows in the Yelm bypass reach and the mainstem of the Nisqually River; and in 1991, Centralia City Light committed to provide instream flows in the Yelm bypass reach. In 1992, a permanent minimum flow regime was agreed to, and is described below.

1. *The flow in the bypass section and in the mainstem of the Nisqually River from La Grande powerhouse to the Yelm Project Diversion shall at all times equal or exceed:*

Date	*Bypass Flow (cfs)*	*Mainstem Flow (cfs)*
October 1 - December 15	*550*	*700*
December 16 - May 31	*600*	*900*
June 1 - July 31	*500*	*750*
August 1 - September 30	*370*	*575*

(Sources: 62 FERC 63,032; R. Whitman, Centralia City Light, personal communication 2001.)

2. *To provide the required flows, Tacoma's releases at the La Grande powerhouse shall be sufficient so that the flow in the mainstem portion of the Nisqually River, measured as the flow reaching the Yelm Project Diversion Dam, shall at all times equal or exceed the greater of: a) those flows specified in paragraph 1 for the bypass less 120 cfs, plus the lesser of 720 cfs or the calculated natural inflow at the Yelm Project Diversion Dam; or b) the flows specified in paragraph 1 above for the mainstem.*

3. *The requirement of paragraph 2(a) may be reduced upon mutual agreement of Tacoma and Centralia in the event that conditions do not permit Centralia to use its full water entitlement, provided that the flow in the mainstem shall never be less than*

in paragraph 1.

4. *The flows in paragraph 1 for June 1 through July 31 shall be extended up to August 15 if-season steelhead spawning data indicate this is warranted, as determined by the NRCC.*

5. *For the period October 1 - December 15, Tacoma agrees to provide higher flows in the mainstem if water conditions are good, and to maintain such higher flow, up to 900 cfs, after it has been established.*

6. *Under adverse water conditions Tacoma may petition the NRCC for modification of these instream flow requirements. (623 FERC 63,032).*

The NRCC now consists of representatives of the Nisqually Tribe, Washington Dept. of Fish and Wildlife, National Marine Fisheries Service, U.S. Fish and Wildlife Service, City of Centralia and Tacoma Public Utilities. This instream flow regime is different from that set by Washington Dept. of Ecology in that it will generally result in the flows specified above in the Nisqually River and bypass reach between RM 40.7 and RM 12.7. Another unusual feature of this instream flow agreement is the ability for operators to provide more flow in the river during fall of high water years, as well as to ask for flexibility in the instream flow requirements during periods of drought.

REVIEW OF INSTREAM FLOW STUDIES

Instream flow studies were done to assist the parties in developing instream flow recommendations. According to the description of the flow negotiations, that many other factors were also considered and negotiated by the NRCC in the development of the final minimum flow recommendations, including the historic importance of fisheries to the tribe, operations of both hydroelectric facilities, and the potential for flexibility during both wet years and drought periods (62 FERC 63,032). The instream flows set through this process appear to be well supported.

The IRPP flows set for the tributaries are not, however, based upon studies of the relationship between flow and fish habitat. Revision of these instream flows is recommended for tributaries where current or future water withdrawals result in significant decreases in the volume of instream water. The Mashel, Muck, Lower Ohop, and Tanwax all have substantial lengths of salmon habitat; hence these are the basins where additional instream flow studies are likely to have the greatest benefit to salmon. Fish populations in other tributaries are primarily resident populations. McAllister Creek does not provide an abundance of fish habitat, but is an area of concentrated development. Review of fish instream flow needs and subsequent review of the instream closures may be in order.